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POSTAL REGULATORY COMMISSION
WASHINGTON, D.C. 20268–0001

Inquiry Concerning City Carrier Costs	Docket No. PI2017-1

RESPONSES OF THE UNITED STATES POSTAL SERVICE TO QUESTIONS 1-20 OF CHAIRMAN'S INFORMATION REQUEST NO. 4

The United States Postal Service hereby provides its responses to the above-listed questions of Chairman's Information Request No. 4, issued on October 31, 2017. Each question is stated verbatim and followed by the response.

Respectfully submitted,

UNITED STATES POSTAL SERVICE

By its attorney:

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1. In Docket No. RM2015-7, the Postal Service noted some of the challenges that it faces in utilizing its Product Tracking and Reporting (PTR) system to track returned mail pieces. Specifically, the Postal Service stated that there are difficulties associated with tracking the record for returned mail pieces because they "may have multiple delivery events for a single barcode, and determining the correct treatment of these pieces can be complex."[1]

a. Please discuss how multiple delivery attempts are identified in the PTR and Delivery Operations Information System (DOIS) databases for accountable mail and packages. In your response, please refer to and identify the relevant database variables provided in the respective folders for the PTR and DOIS databases in Library Reference USPS-PI2017-1/1.[2]

b. Please provide a list of the PTR codes used for attempted deliveries and define each code.[3]

RESPONSE:

a. Each delivery attempt is recorded in PTR with the appropriate scan event type, date, time, and other identifiable information recorded when a scan is performed. Therefore, if delivery of a mail piece was attempted (with a notice left) the first day, and the same piece was then delivered the next day, each scan would appear at the date and time of the scan indicating "Notice Left" and then "Delivered". Each time a carrier takes a parcel out for delivery, the piece is counted in the parcel volume totals for DOIS. Therefore, a parcel that was attempted to be delivered on the first day and was then

[1] Docket No. RM2015-7, Response of the United States Postal Service to UPS Pleading Regarding Commission Order No. 2792, March 11, 2016, at 11 (Docket No. RM2015-7, Response to UPS Pleading).

[2] The PTR variables were provided in Library Reference USPS-PI2017-1/1, July 25, 2017, folder "ChIR.2.Q.10.PTR," Excel file "PTR_Data_Dictionary_ODS.xlsx," and the DOIS variables were provided in Library Reference USPS-PI2017-1/1, folder "ChIR.2.Q.10.DOIS," Excel file "DOIS51Structure61P-140723.xlsx."

[3] The "Comments" section for the PTR variable "ATMTD_EVENT_DATETIME" contains "[t]he earliest attempted delivery event from USPS event code 02 or code 51-57." *See* Library Reference USPS-PI2017-1/1, folder "ChIR.2.Q.10.PTR," Excel file "PTR_Data_Dictionary_ODS.xlsx," row 12,790.

delivered on the second day is counted in the carrier's parcel counts on both the first and second days.

b. The relevant PTR codes and their corresponding definitions are contained in the following table:

PTR Codes and Definitions Associated with Attempted Deliveries

Code	Definition
02	Notice Left
21	No Such Number
22	Insufficient Address
30	No Access
51	Business Closed
53	Receptacle Blocked
54	Receptacle Full/ Item Oversized
55	No Secure Location Available
56	No Authorized Recipient Available
NH	Not Home

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2. In its Docket No. RM2015-7, Response to UPS Pleading, the Postal Service explained that it uses "operational data to directly assign all costs to products" for Sunday delivery because "[t]here is no model, in the usual sense of a set of econometric or engineering equations or proportions that are used to determine cost pools, variabilities or distribution keys." Docket No. RM2015-7, Response to UPS Pleading at 13. The Postal Service stated that it "has a record of the actual costs incurred for Sunday delivery, and simply assigns all of those costs to the packages being delivered on Sunday." *Id.* Please specify and describe the operational data sources that are used to directly assign all Sunday costs to packages delivered on Sunday.

RESPONSE:

The operational sources that are used to assign costs to NSA contract pieces on Sundays and Holidays are: Time and Attendance Collection System (TACS), Product Tracking and Reporting (PTR), Enterprise Analytics -Dynamic Routing Tool (EA-DRT), a Sunday Delivery Reporting website maintained by Delivery Operations, and Revenue, Pieces and Weight (RPW). TACS is the repository for workhours clocked in by City carriers, clerks and supervisors. PTR has the scans needed to identify pieces delivered on Sundays and Holidays. Enterprise Analytics maintains the DRT which uses a routing algorithm to develop routes to be used for delivering the Sunday and Holiday pieces and calculates route miles. The Sunday Delivery Reporting website summarizes data from the above sources for Sundays and Holidays, and also enables manual entry of hours for Rural carriers on Sundays and Holidays. RPW provides NSA-specific volumes for Sundays and Holidays.

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3. In its Response to CHIR No. 1, the Postal Service states that it has "turned its attention away from attempting a special field study for updating Special Purpose Route [(SPR)] costs to the use of operational data." Response to CHIR No. 1, question 4. Please discuss any other options that the Postal Service is considering for updating the SPR costs. Please include in your response any anticipated schedules and resources for those options.

RESPONSE:

The Postal Service is currently pursuing the use of operational data to update Special Purpose Route costs. It is not currently pursuing any other options.

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4. In its Response to CHIR No. 1, the Postal Service states that "[m]any SPR carriers did perform the correct scans, but the proportion correctly recording their daily activity was too low to produce a data set that would yield data of the quality and magnitude required by the Commission." Response to CHIR No. 1, question 4.

a. Please discuss the reasons why the proportion of carriers correctly recording their daily activity was too low to yield adequate data.

b. Please discuss whether using full-time SPR carriers' scans rather than overall SPR carriers' scans would lead to the same conclusion.

RESPONSE:

a. There are a variety of reasons the SPR carriers did not perform the correct scans. The reasons range from the heterogeneity of SPR carrier activities, to the relatively long time between scans on some SPR runs (possibly causing carriers to forget to scan), to a lack of interest or motivation (on the carrier's part) in fully participating in the study.

b. The evidence suggests that just using full-time carriers would lead to the same conclusion as using overall SPR carrier scans. The proof-of-concept studies performed by the Postal Service included sites that primarily employed full-time SPR carriers. The quality of scans taken at these sites was no better than any other sites.

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5. In Docket No. RM2017-9, the Postal Service described firm pickups and bulk delivery as SPR carrier activities.[4] In its Response to CHIR No. 1, however, the Postal Service refers to SPR carriers recording "'Load Vehicle' scans when they [are] away from their base facility in the middle of their runs[]" as errors. Response to CHIR No. 1, question 4. Please explain how loading and unloading the vehicle during firm pickups and bulk delivery away from the carriers' base facility in the middle of their runs would be recorded.

RESPONSE:

In the proof-of-concept studies performed by the Postal Service, the "Load Vehicle" and "Unload Vehicle" scans were associated solely, and by definition, with loading and unloading the vehicle at the home postal facility. The time associated with loading and/or unloading a vehicle during a bulk delivery away from the carriers' base facility in the middle of a run was recorded as part of bulk delivery time. Similarly, the time associated with loading and/or loading the vehicle during a firm pickup was recorded as part of pickup time.

[4] *See* Docket No. RM2017-9, Responses of the United States Postal Service to Questions 1-15, 19-20, and 23 of Chairman's Information Request No. 1, August 9, 2017, question 13.a.

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6. In its Response to Order No. 2792, the Postal Service stated that "[t]he Time Attendance Collection System (TACS) can be used to form separate cost pools for [Labor Distribution Code (LDC)] 23 and LDC 27, but these operational data do not provide any further detail on the time[] required to perform the different specific activities performed by city SPR carriers. Thus, use of operation data is limited to estimating single-equation, 'top-down' equations for each of the two LDCs." Response to Order No. 2792 at 17. Please report any progress on the analysis related to "top-down" equations for these two LDCs and provide any preliminary results, if available. If the Postal Service has not yet begun this analysis, please provide an approximate schedule for it, including a projected date for completion.

RESPONSE:

The Postal Service has been making progress. A first step in estimating "top-down" or any other equations for Special Purpose Route time is constructing the required analysis data set. As explained in the Response to Order No. 2792, a primary challenge in constructing that data set is matching recorded hours with delivered volumes:[5]

> As a first step in the investigation into this approach, an attempt will be made to match relevant work hours from TACS with corresponding volumes extracted from PTR. While this approach seems straightforward in concept, the hurdles to implementation are substantial. As an example, TACS and PTR are separate data systems that record data in different ways with dissimilar identifiers. Initial investigation has shown that matching daily data from the two sources for individual SPR carriers is a formidable challenge. This investigation has just begun, and the Postal Service expects the effort to take several months to complete.

[5] See, Response of The United States Postal Service To Commission Order No. 2792 (February 16, 2016), at 19.

Subsequent to filing that report, the Postal Service pursued alternative approaches to linking the two data systems, and made some progress as indicated by its response to Question 1 in Chairman's Information Request 2:[6]

> Subsequent research into attempting to match the two data systems has been more promising. More recent PTR data appear more complete and seem to provide a reasonable basis for capturing the total volumes of parcels and accountables delivered on a given day. In addition, the Postal Service is currently researching different possible methods of accurately linking volumes and times that do not depend upon traditional identifiers like route number. For example, the Postal Service is attempting to link, for each individual carrier, the recorded delivery time for each delivered package with the associated clock rings for that carrier. Because there are typically over 10 million packages delivered each day, this is a challenging programming task

Following the filing of that response, the Postal Service continued to work on the problem and has made sufficient subsequent progress so that is now feasible to begin the process of constructing an initial analysis data set. This requires, among other tasks, identifying all of the relevant sites from which to obtain data, determining the appropriate time frame for the data set, carefully reviewing of the data to ensure there are no data errors, consulting with operational experts to ensure the data are being interpreted and used properly, and identifying and constructing values for relevant characteristic variables. Once the data set is constructed, estimation of relevant

[6] See, Response to CHIR No. 2, Question 1, Docket No. PI2017-1, July 25, 2017.

variability equations can begin. Equation estimation requires, among other tasks, choice of variables to be included in the model, choice of a functional form, choice of a level of analysis, choice of an estimation technique, evaluation of the econometric properties of the estimated equations, and evaluation of the results. Assuming that no snags are encountered throughout the research process, the Postal Service estimates that accomplishing these tasks will require approximately six months.

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7. In its Response to CHIR No. 2, the Postal Service states that for Mobile Delivery Devices (MDDs) to be used for customer collection volume, "a barcode would have to be used to prompt the carrier to enter customer collection volume at some point along the route." Response to CHIR No. 2, question 2.b. Please discuss how customer collection letters, flats, and parcels would be counted and entered into the MDDs. Please include in your response how the MDD customer collection volume counting process would differ from or be similar to the City Carrier Collection Mail Volume and Source Study (CCCMVSS) process.[7]

RESPONSE:

At the time of the Postal Service's response to Order No. 2792 in February 2016, the Mobile Delivery Devices (MDDs) had been fully deployed for only for six months, and their capabilities were not widely understood. Accordingly, the Postal Service proposed using the processes developed during the successful CCCMVSS as the likely procedures that would be used to capture collection mail. In the spring 2017, however, Enterprise Analytics determined that the MDDs could add functionality for counting mail collected from customer receptacles in a similar fashion that already exists for capturing collection volume from dedicated collection points during the annual National Collection Point Management Density Test.

This revelation led to more focused discussions with Delivery to establish specific procedures that the carrier would perform to measure collection volume. Consideration of the precise procedures is still in the preliminary stages. For this to be done accurately and efficiently, significant cooperation is required from delivery operations.

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[7] In its Response to Order No. 2792, the Postal Service stated that "[i]f recording of collection mail were to be done on a daily basis, it would be appropriate for carriers to record collected letters and flats in terms of linear measurements as they did in the [CCCMVSS] rather than conduct piece counts." Response to Order No. 2792 at 10. The Postal Service noted that collected parcels, however, would be entered with piece counts. *Id.* at 11.

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Initial discussions have resulted in the following steps being contemplated for the carrier to count collection mail:

1) Upon returning to the office, city letter route carriers scan the MSP Return to Office barcode.

2) The MDD would then prompt the carrier to enter separate linear measurements for total letter and flat collection mail volume in tubs and trays.

Because of the labor cost associated with measuring collection mail, this feature of the MDD would be used sparingly. Using an estimate of four minutes of carrier time per route day and the FY 2016 City Carrier average wage rate of $40.90, the estimated direct cost per route day is $2.73. Adding indirect costs increases the daily cost to $3.63. Extrapolating this cost to 140,000 city letter routes results in a daily cost estimate of nearly $508,000.

The principal objective of an MDD measurement effort and the CCCMVSS are similar, but there are potential differences in procedures between using MDDs and what was done during the CCCMVSS. In CCCMVSS, collection mail was captured separately from three sources 1) customer receptacles, 2) collection points, and 3) containerized mail from businesses. For sources 1) and 2), separate linear measurements were done for letters and flats, and piece counts were done for parcels. In contrast, under the MDD approach, collection mail from all three sources would be combined before being entered into the MDD. Also letter and flat collection volume would be combined for one measurement, rather than conducting separate measurements for letters and flats. However, separate measurements would be

entered for trays and tubs. Separate measurements for trays and tubs are being considered to prevent well organized and prepared metered mail in trays from being dumped into a tub for measurement. Another difference between using MDDs and CCCMVSS is that, under the new approach, parcel collection volume would be captured through data obtained by Package Pickup, rather than the carrier entering separate piece counts for collected parcels, as was done during the CCCMVSS. These modifications are being considered to reduce carrier labor costs without losing the needed information for the city carrier street model. These proposed changes in procedures between CCCMVSS and using MDDS are not as dramatic as they may appear. Because collection points are easily identified, collection volume captured from dedicated collection points can be accounted for by including the number of dedicated collection points per route. Also, collected flats are not common, so collecting volume from one measurement rather than two will not materially underestimate the volume collected. Moreover, the growth of the Package Pickup program since the CCCMVSS has resulted in more collected parcels entering the mail stream under that program, which lends itself to capturing collected parcels in an automated fashion, rather than relying on time-consuming piece counts by carriers. In sum, the Postal Service believes the draft procedures for capturing collection volume have the potential to provide meaningful information that could be used to develop a carrier street time model. However, the material cost of capturing this information is a legitimate concern that could impede or prevent its implementation.

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8. In the Status Report on the Top-Down Equation, the Postal Service states that "the acquisition of volumes of mail collected by city carriers from customers' receptacles" will require a special field study or a special application of the carriers' MDDs. Status Report on the Top-Down Equation at 2.

a. Please discuss the feasibility of reprogramming the carriers' MDDs for the acquisition of mail volumes collected from customer receptacles.

b. Please provide approximate estimates of the time and cost required to develop and implement a special application for MDDs referenced in the Status Report on the Top-Down Equation.

RESPONSE:

a. The MDDs can be reprogrammed to add the functionality of capturing collection mail.

b. The estimated IT costs including coding changes and testing are $42 thousand and likely could be implemented within 9 months after being initiated. However, the IT costs are very small compared to the carrier labor costs of utilizing this added functionality to the MDD. As described in the response to item 7 of this Information Request, implementing this across the entire city carrier letter route network would be estimated to cost approximately $500 thousand per day.

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9. In its Response to Order No. 2792, the Postal Service stated that it believed that "five to seven percent of delivered parcels do not have tracking barcodes, and [that the PTR] would not count those parcels. However, the proportion of parcels without tracking barcodes should decrease with time." Response to Order No. 2792 at 8.

a. Please specify the current percentage of delivered parcels that do not have tracking barcodes.

b. Please explain the methodology, and identify the sources, for determining the percentage of parcels that do not have tracking barcodes.

RESPONSE:

a. and b. There is no definitive system that identifies parcels that lack tracking barcodes. Using the ODIS-RPW probability sampling system, we estimate that during Quarter 4, FY2017 1.07 percent of parcels did not have a barcode and 1.47 percent cannot be scanned or entered. These are options presented to the ODIS-RPW data collector when recording information about a parcel (ODIS-RPW does not collect scan information for all parcels, and specifically excludes Priority Mail Express). Since there is a possibility that an ODIS-RPW data collector could record a parcel without a barcode in the category of 'cannot be scanned or entered', we would state that the actual number for the parcels that ODIS-RPW collects barcode information is between 1.47 percent and 2.54 percent; the sum of the above percentages. The ODIS-RPW probability sampling system was last discussed with the Commission in Docket RM2017-7.

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10. In its Response to CHIR No. 2, the Postal Service provides a list of variables recorded in the DOIS database.[8] Please provide a data dictionary that includes the descriptive meanings of the variables and the meanings of the codes used within those variables, where applicable.

RESPONSE:

Available requested information is being provided in USPS-PI2017-1/3.

[8] Response to CHIR No. 2, question 10; *see* Library Reference USPS-PI2017-1/1, folder "ChIR.2.Q.10.DOIS," Excel file "DOIS51Structure61P-140723.xlsx," column "NAME."

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11. In its Response to CHIR No. 2, the Postal Service states that the City Carrier Cost System-Special Purpose Route (CCCS-SPR) "does not currently sample Collection routes, so that a large percentage of SPR time could not be analyzed." Response to CHIR No. 2, question 6.d.

a. Please explain why the CCCS-SPR does not currently sample Collection routes.

b. Please describe the distribution key source and process for distributing street Collection route costs to products.

RESPONSE:

a. There are multiple reasons why CCCS-SPR does not sample collection mail. First, it has been assumed that the distribution key for mail collected by SPR carriers is similar to the mail collected from blue boxes by letter carriers, i.e. 95 percent First-Class letters and flats. Second, because SPR carriers collect large volumes of mail, sometimes multiple hampers, the sampling procedures currently used on CCS tests, which involve counting each piece of mail, are not practical or appropriate. Third, SPR carriers who collect mail clock to LDC 27 primarily, though not exclusively, and some collection occurs while clocked to LDC 23. A new subsystem designed to sample collection mail would have to develop a new frame that included routes that are clocked to LDC 27, but would also have to include those LDC 23 routes that could obtain collection mail. The new subsystem would also have to develop new procedures to sample large quantities of collection mail. Given that the vast majority of collection mail is First-Class Single Piece Letters, it is unlikely that a new sampling subsystem would contribute significantly to the development of product costs.

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b. Street collection costs on SPR routes are developed in workbook CS06&7-Public-FY16.xlsx, worksheet 7.0.5, filed in USPS-FY16-32. SPR street time costs are first split into costs for drive (of which a portion is considered activity-related), stop, and travel/support. The street time proportion for street box collection are 37.52 percent for activity-related drive time and 17.76 percent for stop time, as shown on worksheet 7.0.5, row 39. The resulting drive and stop cost pool amounts are shown on row 48. Cost pool totals are multiplied by the relevant variability factors, shown on rows 29 and 30. Volume variable stop time costs are distributed on worksheet 7.0.6, columns I and D, and volume variable drive time costs are distributed on worksheet 7.0.6, column L. These distribution keys are developed from worksheet 7.0.9, column E, based on the CCCS Blue Box collection data (worksheet "Input DK", column M) with additional refinement of product categories using RPW data (worksheet 7.0.9, column D). RPW data are used to split combined First-Class Single-Piece combined letters and flats into individual card, letter and flat products. Similarly, Marketing Mail combined letter and flats are split into individual letter and flat products, and Periodicals are split into In-County and Outside-County products.

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12. The Postal Service's top-down model prototype uses the ZIP Code-day unit of observation. *See* Status Report on the Top-Down Equation at 17. By contrast, the CCCS uses "route-days" as its first-stage sample selection unit.[9] The CCCS randomly selects route-days within each geographically-ordered sample stratum. *Id.*

a. Please describe how the prototype top-down model's ZIP Codes were selected. Please describe the ZIP Codes selected in the same level of technical detail as that provided in Library Reference PRC-RM2011-3-LR-1.[10]

b. Please describe how the prototype top-down model's ZIP Code-days differ from the CCCS's route-days/geographic indicators.

c. Please specify the geographic level used in the CCCS sample selection process for the "geographically ordered" step noted in the question preface.

RESPONSE:

a. The 300 ZIP Codes used for the top down model filed in the instant docket were the same ZIP Codes that were used for both the City Carrier Collection Mail Volume and Source Study (CCCMVSS) and the Package and Accountable Field Study in Docket No. RM2015-7. The sample design was thoroughly explained in USPS-RM2015-7/1, Report on the City Carrier Street Time Study at 27-29.

b. The principal difference between the prototype top-down model's ZIP Code days and CCCS's route days is the Primary Sampling Unit (PSU). The PSU for the top down model is ZIP Code-day, but for CCCS the PSU is route-day. Both utilized a systematic sample design, but mechanically there are minor differences in how the frame is ordered before the PSUs are selected. The top down model ordered the ZIPs within

[9] *See* Docket No. ACR2016, Library Reference USPS-FY16-34, December 29, 2016, file "USPS-FY16-34_CCCS_Preface_Final.pdf," at 4.

[10] Docket No. RM2011-3, Library Reference PRC-RM2011-3-LR1, August 13, 2013.

each stratum before applying the systematic design. As stated in part c of this item, CCCS orders by District and ZIP within each stratum before applying the systematic design.

c. CCCS sample selection is geographically ordered by district and by 5-digit ZIP Code within each stratum.

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13. In its Status Report on the Top-Down Equation, the Postal Service states that it also collected data for September 2016 and combined it with the July 2016 data in order to re-estimate the top-down model on a larger data set. Status Report on the Top-Down Equation at 32. The Postal Service also states that multicollinearity "will almost certainly be a major problem for estimating a top-down model." *Id.* at 13.

a. Please discuss the reasons why September was chosen rather than August or another month.

b. Please discuss whether the Postal Service has attempted to use an expanded dataset in order to estimate a top-down equation (*e.g.,* by including data for more than 300 ZIP Codes or additional days outside the months of July and September). If so, please describe the modifications that the Postal Service made to the input datasets, providing all of the applicable documentation, including SAS data files and regression outputs.

c. Please indicate whether the Postal Service has applied any methods for analyzing and curing multicollinearity (*e.g*., principal component analysis or ridge regression). If so, please discuss the effectiveness of these methods and provide all of the supporting documentation. If the Postal Service has not applied any methods in an attempt to decrease multicollinearity in the top-down models, please explain why not.

RESPONSE:

a. July was originally chosen because the Postal Service research showed the PTR system was running with sufficiently reliability at that time:[11]

> Data were originally obtained from DOIS and PTR for July 2016 because the Postal Service had confidence that the PTR reporting mechanisms were firmly in place by that time

[11] See, Status Report on the Top-Down Equation, Docket No. PI2017-1, August 18, 2017 at 32.

September was chosen because, when the research was being performed, September was the most recent month in which new data were available. In other words, September was the farthest away month for which new data were available.

b. It has not.

c. Yes, the Postal Service considered principal components, ridge regression, and FGLS. For a discussion of the issues associated with applying principle components and FGLS, please see the response to question 15 of this Information Request. The ridge regression method is discussed in this response.

Because it does not require eliminating the structural variables for which variabilities are required, the ridge regression approach is, in a sense, more feasible for application to the top-down equation than principle components. However, the ridge regression approach is not without its important drawbacks.

One of the symptoms of multicollinearity is that, although the parameter estimates are unbiased, their variances can be quite large, meaning that the parameter estimates potentially can be unstable and can take on large values. A ridge estimator reduces the estimated variance by modifying the matrix of right-hand-side variable in a way that mitigates the impact of the collinearity. Specifically a ridge parameter, often called λ, is entered in the estimator in the following way:

$$\beta_{RIDGE} = (X'X + \lambda I)^{-1} X'y,$$

where I is the identity matrix. While it is not obvious from the above formula, the ridge (or "shrinkage") parameter penalizes large values of the estimated parameter, effectively shrinking those estimates toward zero. Instead of minimizing the traditional sum of squares as an OLS estimator does, the ridge estimator minimizes a modified version of the sum of squares:

$$\beta_{RIDGE} = \ argmin \sum_{i=1}^{n} (y_i - x_i'\beta)^2 + \ \lambda \sum_{j=1}^{p} \beta_j^2.$$

This formulation shows the role that λ plays, penalizing large values of the estimated parameters. Minimizing this modified sum of squares requires estimating smaller β coefficients to avoid incurring the penalty. The larger the value of λ, the more the estimated parameters are moved toward zero. In other words, the larger the value of λ, the greater the shrinkage in parameter estimates. In dealing with multicollinearity, the advantage of the ridge estimator is that it reduces the estimated variances of the parameters, reducing their potential instability. But this gain comes at a cost. Inclusion of λ also produces biased estimates for the parameters. The bias associated with the ridge regression is given by:

$$Bias\left(\beta_{Ridge}\right) = \ -\lambda(X'X + \lambda I)^{-1}\beta.$$

The existence of bias in the estimated parameters may not be of concern if the resulting equation were to be used for forecasting, in which the ability of the overall equation to predict is important, but the values of individual coefficients are not critical. However,

bias is a serious concern for the estimation of the top-down equation, because the individual coefficients constitute the required variabilities. In particular, there could be a concern that using a ridge regression could lead to a downward bias for the estimated parameters and resulting variabilities. The primary purpose of the top-down equation is to estimate those coefficients. While OLS estimates have inflated variances, they are unbiased.

A second difficulty with ridge regression is that there are no clear guidelines or rules for selecting the value of λ. A high value for λ will reduce the variance but will increase the bias, so finding the best value can be quite important for pursing a successful ridge regression. Algorithms for selecting the ridge parameter can substantially increase the complexity of and resources needed for estimating a ridge regression.

Given the complexities and drawbacks associated with ridge regression, and given that analysis of the top-down equation is still at the exploratory stage (e.g. data do not yet exists for volume collected, so all of the variables included in the $X'X$ matrix are not yet available), the Postal Service determined it was premature to further pursue the approach.

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14. Please refer to Library Reference USPS-PI2017-1/2, August 18, 2017, folder "SAS Data Sets," "study_dois_pa_vol_july.sas7bdat" and "study_dois_pa_vol_july_sept.sas7bdat," the input datasets for the Postal Service's top-down models. These two files include FY 2016 data for the month of July and the combined months of July and September.

a. Please describe any differences between the resources (*e.g.*, time, software, hardware capability, and cost) required to generate these two datasets.

b. Please explain how expanding these datasets to include data for additional months would affect the resources required to generate SAS datasets and/or estimate regression models.

c. Please explain how expanding these datasets to include data for additional ZIP Codes would affect the resources required to generate SAS datasets and/or estimate regression models.

d. Please identify the major factors that create the upper limits for expanding the input datasets by adding data on additional months or ZIP Codes.

RESPONSE:

a. The resource cost of generating two datasets was essentially twice the resource cost of providing one dataset.

b. Expanding the data sets to include additional months would cause the resource cost of constructing the SAS datasets to rise proportionally. In other words, it would take six times as long to produce six months of data as it did to produce one month of data. Estimating the regression should not grow proportionately. However, as the time dimension of the data set grows, time related issues like seasonality and autocorrelation arise, increasing the time required for estimating the regression.

c. The resources required to obtain the data are essentially proportional to the number of observations. There are minimal resource economies achieved from obtaining a

larger dataset. This means that a dataset twice the size would require nearly twice the resources.

d. The major factors are the time and resources required to download the data from the Postal Service operating data systems, the time and resources required to combine the raw data into useable input data sets, the time and resources required to review the data to ensure they do not contain anomalies or data errors, and the time and resources required to estimate a top-down model and investigate the multitude of econometric issues associated with that estimation, like those raised in this Chairman's Information Request. Taken together, such an effort can consume a substantial amount of time and resources.

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15. Please indicate whether the Postal Service considered multiple methods in estimating its prototype top-down models' regression parameters. If so, please explain why these methods were rejected and the ordinary least squares (OLS) regression fitting method was selected. If the Postal Service only considered OLS, please explain why it did not consider other methods, such as feasible generalized least squares (FGLS).

RESPONSE:

Yes it did. Principal components is a relatively sophisticated method for reducing the dimension of the X'X matrix and producing regressors that are not correlated with one another. It depends upon creating new variables, sometimes known as principal factors, which are linear combinations of the original variables. Typically there are fewer principal factors (or components) used than original variables, facilitating estimation. However, a drawback of the principle components approach is the difficulty providing economic interpretations for the estimated coefficients. The principle components are combinations of the original variables and are not one-to-one transformations of those variables, meaning the implied coefficients for the original variables cannot be retrieved. This reduces or eliminates the usefulness of principal components when estimating a structural equation, like the top-down model, in which estimating the coefficients on each structural variable is essential for the analysis. In other words, the best that principle components could do is to produce variabilities for different linear combinations of DPS letters, cased mail, FSS flats, sequences mail and parcels (and collection mail if available), but not the required variabilities for the shapes themselves. Because of this limitation, the principle components approach was not pursued.

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Feasible generalized least squares (FGLS) is also a potential method of correcting for heteroscedasticity that was considered by the Postal Service. FGLS is an attempt at implementing a generalized least squares (GLS) approach to correcting heteroscedasticity. The GLS estimator is implemented by linearly transforming the data used to estimate the equation and then applying OLS to the transformed data. The GLS estimator is given by:

$$\beta_{GLS} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}y.$$

With the following variance:

$$VAR(\beta_{GLS}) = (X'\Omega^{-1}X)^{-1}.$$

This formula shows how GLS can be used to estimate a model in the face of heteroscedasticity, because the estimator embodies a non-constant error variance. The severe drawback of GLS is that the variance/covariance matrix, Ω, is almost never known. This difficulty leads to the development of FGLS, in which an estimated value of Ω, based upon the input data, is used in place of its actual value:

$$\beta_{FGLS} = \left(X'\widehat{\Omega}^{-1}X\right)^{-1}X'\widehat{\Omega}^{-1}y.$$

The variance formula changes in the same way:

$$VAR(\beta_{FGLS}) = \left(X'\widehat{\Omega}^{-1}X\right)^{-1}.$$

Thus, FGLS would appear to provide a convenient and reliable way to deal with heteroscedasticity, but it, too, faces a serious difficulty. To estimate the Ω matrix, one

must estimate each element of the matrix. But the dimensions of the Ω matrix are TxT, where T is the number of observations. That means to estimate Ω, one must estimate T^2 elements, but that exceeds the number of observations.[12] Thus, there are not enough degrees of freedom to estimate Ω.

To circumvent the degrees of freedom problem, one must put restrictions on Ω by making assumptions about the underlying model generating the heteroscedastic errors. This is feasible when there is extra-model information about the source of the heteroscedasticity, but is a real problem in cases like the top-down model, in which the source is unknown. Then assumptions must be made about the nature of the heteroscedasticity, and if those assumptions are not accurate, the proposed model of heteroscedasticity will not be an accurate representation of the true model. In this circumstance, the beneficial efficiency properties of FGLS will not hold. Because of this uncertainty, the Postal Service used the White estimator that produces unbiased estimates of the parameters and robust standard errors that support reliable statistical inferences in the face of heteroscedasticity.

[12] Because Ω is a symmetric matrix there are only ½ T(T-1) individual elements, but this still exceeds the number of observations.

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16. In the Status Report on the Top-Down Equation, the Postal Service indicates that the differences between FSS ZIP Codes and non-FSS ZIP Codes might be due to "reasons other than the existence of FSS processing." Status Report on the Top-Down Equation at 24. In Tables 9 and 10 of the referenced report, the Postal Service provides the regression coefficients for the variables included in the top-down equation and estimated using data for either FSS ZIP Codes (Table 9) or non-FSS ZIP Codes (Table 10). *Id*. at 26, 28.

a. Please explain the reasons for the notable differences between the regression coefficients estimated for the same variables and presented in Table 9 and Table 10.

b. Please discuss whether the Postal Service has performed any diagnostic tests (*e.g.*, Durbin-Wu-Hausman test) for possible inconsistency of the OLS estimator due to unobserved differences between FSS ZIP Codes and non-FSS ZIP Codes. If such tests were conducted, please provide the output and explain whether they support the application of the OLS estimator.

RESPONSE:

a. There are number of potential reasons for the differences. First, the existence of FSS mail means that in FSS ZIP Codes, carriers must contend with an additional bundle of mail on the street. This can change carrier actions and affect the times associated with delivering not just FSS mail, but the other bundles of mail as well, causing the estimated coefficients to differ between FSS and non-FSS ZIP Codes. Second, the composition of cased mail is likely to be different in FSS and non FSS ZIP Codes, with the mail being "cleaner" in non-FSS zones. This is because machinable mail tends to be more regularly shaped and easier to handle than non-machinable mail. Consequently, cased mail may be more difficult and time consuming to handle, on a per piece basis, in FSS ZIP Codes, causing the estimated coefficients to differ for those ZIP Codes. Third, volumes are higher in FSS ZIP Codes than in non-FSS ZIP Codes,

implying that coverage is higher. In a ZIP Code with high coverage, a sequenced mailing will tend to cause less additional accesses than it would in a ZIP Code with low coverage. As a result, the marginal time for a piece of sequenced mail would likely be higher in relatively low coverage, non-FSS zones than in relatively high coverage FSS zones. This would cause the estimated coefficients to differ across the two types of ZIP Codes.

Finally, the estimated coefficients likely differ due to multicollinearity. Splitting the data set into FSS and non-FSS ZIP Codes necessarily means estimating the two separate equations on smaller subsets of data, potentially exacerbating the impact of collinearity among the explanatory variables. There is empirical evidence to support this contention. For example, for FSS ZIP Codes:[13]

> The number of coefficients which are not statistically significantly is higher for the FSS equation than it is for the overall equation, with 27, or 46.6 percent, not achieving that standard. In addition, the Condition Index is 142.42 which is well above the value of 110.57 for the top-down equation estimated on all observations. To a degree, this result is not surprising, as the number of observations is much smaller for estimating the FSS-only equation, but it may also reflect a tighter correlation among right-hand-side variables in FSS zones.

And for non-FSS zones:[14]

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[13] See, Status Report on the Top-Down Equation, Docket No. PI2017-1, August 18, 2017 at 25.

[14] Id. at 27.

> Multicollinearity remains a problem for the non-FSS zone equation, nonetheless, as 40 of 49 estimated coefficients (81.6 percent) have a VIF greater than 10 and the condition index remains above 100.

Another piece of empirical evidence on the role of multicollinearity causing differences in the estimated coefficients comes from estimating the top-down model with a unified parcel variable included instead of separate variables for in-receptacle and deviation parcels. This version reduces the number of right-hand-side variables and helps mitigate the multicollinearity problem. Table 12 from the Status Report is reproduced below, and it shows results from when the unified parcel variable is included. The differences in marginal times are reasonable and reflect the expect differences between FSS ZIP Codes and non-FSS ZIP Codes discussed earlier in this response.

Table 12

Marginal Times Arising from Separately Estimating Top Down Equations by FSS and non-FSS Zones with a Unified Parcel Variable

Volume Shape	FSS ZONES	Non-FSS Zones	Combined
DPS	1.9	2.2	2.1
Cased	9.2	5.9	6.8
Sequenced	2.3	4.7	3.6
FSS	6.2		6.2
Parcel	21.7	28.4	26
Acct	-339	264	51.9

b. No, because no such tests were necessary, for two reasons. First, as the response to part a reveals, the differences in coefficients appear to be due to observed

differences in the two types of ZIP Codes and multicollinearity. Second, and more importantly, the Postal Service is not advocating use of the OLS to estimate a single top-down equation covering both types of ZIP Codes. Rather, the Postal Service is suggesting that it would be appropriate to estimate separate equations for FSS and non-FSS zones in which any differences between the two zones are explicitly accounted for in the estimated coefficients.

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17. In the Status Report on the Top-Down Equation, the Postal Service indicates that it detected heteroscedasticity related to ZIP Code size by performing the White test. Status Report on the Top-Down Equation at 18. Please indicate whether the Postal Service has performed any other diagnostic tests (*e.g.,* the Breusch-Pagan or Honda tests) to detect the presence of ZIP Code-specific heteroscedasticity. If such tests were conducted, please provide their outputs and explain whether the results of these tests support the application of the OLS estimator the Postal Service used for its top-down models.

RESPONSE:

Given the confirmation of heteroscedasticity in similar data sets in both Docket No. R2005-1 and Docket No. RM2015-7, and given the extreme p-values for the White tests performed for the various top-down models, those results can be considered determinative. However, to allay any concerns by the Commission that heteroscedasticity might not be present, the Bruesch-Pagan test was performed for the full top–down model based upon both July and September data. The resulting Bruesch-Pagan statistic was 1155 with an associated p-value of less than 0.001, confirming the presence of heteroscedasticity.

Also, please note that the top-down model was not estimated using ordinary least squares (OLS). Rather, it was estimated using a sandwich or White/Huber estimator. It is well known that in the presence of heteroscedasticity, the OLS estimator is unbiased and consistent, but is not efficient and produces biased standard errors. An effective and widely-used method to deal with heteroscedasticity is to estimate robust standard errors that account for the heteroscedasticity. The sandwich or White estimator provides such robust standard errors by accounting for a non-constant error variance. This can

be seen by comparing the formulas for the variances of the estimated coefficients for the two estimators. Under OLS the variance is given by:

$$VAR(\hat{\beta}_{OLS}) = \sigma^2(X'X)^{-1}.$$

This formula shows the assumption of a constant error variance. In the White estimator, the variance is non-constant:

$$VAR(\hat{\beta}_{Robust}) = (X'X)^{-1}X'\Sigma X(X'X)^{-1}.$$

This is the estimator used for the top-down model.

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18. Please discuss the efforts that the Postal Service has made to explore the panel structure of input data used for top-down equations (*e.g.*, investigating the use of random effects or fixed effects).

RESPONSE:

Previous to this docket, the Postal Service explored the panel data structure of this type of carrier street time data and demonstrated that the use of a panel data estimator produced unreasonably low variability estimates:[15]

> While the results for regular delivery appear plausible in the sense they have the correct signs and relative magnitudes, they are far lower than previous delivery variability estimates for the Postal Service and other postal administrations. The regular delivery variabilities imply that a doubling of all volumes delivered on city routes would cause only 7 percent increase in delivery time.
>
> One possible reason for these low variabilities is the "within" nature of the fixed-effects estimator. This estimator focuses on the movement of volume and delivery time across the observations for the individual units. If that response is muted because of inflexibility in the carrier day, then the estimated variabilities may be understated. For example, is there is a short run absorption of temporary changes in volume, that is not sustained in the long run, then the day-to-day variabilities may understate the true response to a sustained change in volume. Because of the low values for the regular delivery variabilities, the fixed effects results are not preferred to the pooled model results.

Exploratory analysis of panel structure of the input data used to estimate a linear version of the top-down equation again showed this to be true, so no further research in this area was pursued.

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[15] See, "Testimony of Michael D. Bradley on Behalf of the United States Postal Service," USPS-T-14, Docket No. R2005-1, April 8, 2005 at 44.

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19. In Docket No. RM2011-3, in the Scoping Study Report,[16] the Postal Service stated that "[r]esearch in the area of carrier street time has identified two functional forms that can be successfully used in estimating street time variabilities: the quadratic form and translog form." Scoping Study Report at 45-46. The Postal Service also indicated that the translog form "cannot be used to estimate equations in which the right-hand-side variables take zero values." *Id.* at 46. The Postal Service also states that because "certain cost drivers…can take on zero values at both the route and ZIP Code levels," the "translog form has a major drawback for estimating street time equation." *Id.*

a. Please provide all of the technical documentation underlying the above-referenced research and supporting the conclusion that only two functional forms (quadratic and translog) can be successfully used in estimating street time variabilities. In your response, please identify which other functional forms were investigated and explain why each was rejected.

b. Please confirm that the Postal Service has not tested any alternative functional forms for its top-down prototype models. If not confirmed, please explain why those alternative functional forms were rejected. Please include regression outputs and any other applicable documentation.

RESPONSE:

The question appears to misinterpret what the Postal Service said in the Scoping Study Report. For sake of reference, here is the complete quote from that Report:[17]

> Research in the area of carrier street time has identified two functional forms that can be successfully used in estimating street time variabilities: the quadratic form and the translog form. Both are "flexible" functional forms in the sense that they impose relatively little restriction on the shape of the delivery time regression equation. Thus, unlike a restrictive functional form like the Cobb-Douglas form, the flexible functional forms allow the data to dictate the shape of the estimated function. This means that the degree (or even

[16] Docket No. RM2011-3, Scoping Study Report of the United States Postal Service, May 25, 2012 (Scoping Study Report).

[17] Id.

> presence) of density economies is not pre-ordained by the model selection.

Please note that, unlike what is stated in the question, in the Report, there is no claim that only two function forms can be successfully used in estimating street time variabilities. Rather the Scoping Study Report claimed that the translog and quadratic functions had been used to successfully estimate carrier street equations in previous research. That research was both in the regulatory forum and in the academic forum. For example, in the regulatory forum, both the Postal Regulatory Commission and the Postal Service had employed the quadratic functional form in estimating various carrier street time model across a number of dockets:[18]

> In the area of city carrier delivery, previous work has shown the quadratic functional form to be useful. It was specified by both the Postal Service and the Commission in estimating models for load time and access time. These two components make up the overwhelming majority of volume variable delivery time, so the application of a quadratic form would be appropriate for delivery time.

Academic researchers have also noted the utility of the quadratic functional form and used it in estimating carrier street time equations:[19]

> A quadratic functional form is used. As explained in the previous section, the functional form provides a readily

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[18] See, Testimony of Michael D. Bradley on Behalf of the United States Postal Service," USPS-T-14, Docket No. R2005-1, April 8, 2005 at 28.

[19] See, Farsi, Mehdi, Filippini, Massimo, and Trinkner, Urs, "Economies of Scale, Density, and Scope in Swiss Post's Mail Delivery," in Liberalization of the Postal and Delivery Sector," Michael Crew and Paul Kleindorfer (eds.),Edward Elgar, 2006, at 94.

applicable expression for the economies of scope. Moreover, because of the presence of zero parcel output in some of the delivery units (about 12.5 percent of the sample) logarithmic forms like Cobb-Douglas and translog would require additional adjustments.

Below is a list of studies that have used the quadratic and translog form in estimating carrier street time equations.

Cazals, Catherine, Florens, Jean-Pierre, and Soteri, Soterios, "Delivery Costs for Postal Services in the UK: Some Results on Scale Economies with Panel Data," in Regulatory and Economic Challenges in the Postal and Delivery Sector, Michael Crew and Paul Kleindorfer (eds.), Kluwer, 2005

Testimony of Michael D. Bradley on Behalf of the United States Postal Service," USPS-T-14, Docket No. R2005-1, April 8, 2005

Farsi, Mehdi, Filippini, Massimo, and Trinkner, Urs, "Economies of Scale, Density, and Scope in Swiss Post's Mail Delivery," in Liberalization of the Postal and Delivery Sector," Michael Crew and Paul Kleindorfer (eds.),Edward Elgar, 2006 T-14, Docket No. R2005-1, April 8, 2005

Bradley, Michael D., Colvin, Jeff and Perkins, Mary K., "Measuring Scale and Scope Economies with a Structural Model of Postal Delivery in Liberalization of the Postal and Delivery Sector," Michael Crew and Paul Kleindorfer (eds.), Edward Elgar, 2006, 103-119.

Cazals, Catherine, Florens, Jean-Pierre and Roy, Florens, "An Analysis of Some Specific Cost Drivers in the Delivery Activity," in Future Directions in Postal Reform. Topics in Regulatory Economics and Policy Series, Michael Crew and Paul Kleindorfer (eds.), Springer, 2011, 197-211.

United States Postal Service, "Report on City Carrier Street Time Study" in USPS-RM2015-7/1, Docket No. RM2015-1, December 2014.

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20. In the Status Report on the Top-Down Equation, the Postal Service states that "the top-down model was not able to provide reliable estimates of an accountable elasticity and marginal time" because accountable volumes are "so small relative to letter and flat volumes." Status Report on the Top-Down Equation at 39.

a. Please indicate whether the Postal Service has investigated whether combining accountable mail with deviation parcels could improve estimates of accountable elasticity and marginal time. Please provide the results of such investigation including SAS data files and regression outputs, if applicable.

b. Please indicate whether the Postal Service has investigated the feasibility of eliminating some or all of the variables related to the accountable mail from the prototype top-down model. If the Postal Service has attempted to do so, please discuss the resulting impact on the estimated coefficients and statistics of the regression equation. If the Postal Service has not considered such elimination or believes that it is not feasible, please explain why not.

c. Please discuss the feasibility of expanding the input datasets by including delivery routes with higher accountable mail volumes.

RESPONSE:

a. Previous research has shown that the elasticities and marginal times for deviation parcels are quite different than for accountables. For example, the established variability for deviation parcels is 31.1 percent, whereas the established variability for accountables is 18.0 percent. Given these differences, it did not seem appropriate to combine the two types of volume into one variable, and the Postal Service did not estimate a version of the top-down model with the two combined.

b. Before receiving this question, the Postal Service did investigate the feasibility of eliminating all of the variables related to the accountable mail from the prototype top-down model, but did not investigate the feasibility of eliminating some of the variables related to the accountable mail from the prototype top-down model. Eliminating all of

the accountable variables (essentially dropping accountables from the equation) had little effect on the other variabilities, but eliminated the top-down model's ability to estimate a variability for accountables. In such an approach, a supplemental analysis would be needed to estimate a variability for accountables. If the same approach was taken for parcels, then a supplemental analysis would also be needed for parcels, and the top-down model is then essentially identical in specification to the delivery time model in the established methodology.

The Postal Service did not investigate the feasibility of eliminating some of the variables related to accountable mail from the prototype top-down model because the problem with accountables is not multicollinearity, but rather that volumes are so small relative to letter and flat volumes. Dropping variables is a remedy for multicollinearity, but would not appear to be a remedy for the small-volume problem. However in response to this question, the Postal Service did investigate the suggestion. A good place to start is the version of the top-down model that is estimated with a unified parcel variable for FSS ZIP Codes. The estimated accountable variability and the estimated accountable marginal time are negative for that version, so a quick evaluation of the effectiveness of dropping accountable variables is to see if that approach would turn the variability and marginal time positive. The Postal Service estimated the top-down model with a unified parcel variable for FSS zones, but dropping all accountable variables except for the first and second order terms for accountables. That is, all cross-product terms involving accountables were dropped from the equation. The version of the top-

down model without the cross-product terms involving accountables continued to produce a negative variability and marginal time for accountables, suggesting that dropping accountables terms does not effectively address the problem.

c. This suggestion bears investigation going forward, but the number of accountables in a typical ZIP Code is so low that it may be difficult to implement. The disparity between accountable volumes and other volumes is quite large:[20]

> For example, a typical route may involve delivery of over 2000 letters and flats per day, but will only have delivery of 1 or 2 accountables, if any. A typical amount of street time is 6.5 hours per route per day, which is 23,400 seconds. If a route gets one accountable that takes 60 seconds to deliver, accountables would cause around two--tenths of one percent (0.002) of street time. There are many non-volume reasons that street time could vary across two routes by 60 seconds (congestion, a customer greeting, and weather), particularly when the dependent variable includes allied time.

This means that identifying ZIP Codes with two or three times the average number of accountables will still yield a disparity in the range of 2000 letters and flats to 2 to 6 parcels. Such an approach is unlikely to resolve the issue. The concern is that ZIP Codes that do have a large enough numbers of accountables to materially reduce the gap may not only be extremely rare, but also may well be appreciably different from

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[20] See, Status Report on the Top-Down Equation, Docket No. PI2017-1, August 18, 2017 at 15.

typical ZIP Codes. If so, oversampling them may contaminate the overall data set and lead to misleading estimate of the variabilities for the other variables.